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A Novel Approach Evaluation for Enhancing Networks

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Abstract

This study reveals for a creation of a system that has the ability to prove the technical feasibility and the advantages of a joint Radio Frequency and fiber optic system with self-trace directional control between deployed network nodes in the low space. Sky's mesh network utilizing aerial altitude platform stations (AAPS) are driven via Wi-Fi and optical fiber to support and strengthen the capacity of network nodes by acquiring high quality coverage. The mechanism of AAPS Face a real challenge of precariousness due to winds; this challenge hinders network deployment due to loss of the line of sight (LoS). A smart communication platform system (SCPS) base station is proposed to overcome the limitations. Research aimed to evaluate the SCPS mechanism, to verify aptitude of system performance which is used to handling and supporting the communication networks in disaster areas.

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Keywords: Aerial altitude platform system (AAPS), free space optics (FSO), disasters area, smart communication platform system (SCPS), Fiber-Optic Connection.

1. Introduction

The facilities provided by the use of communications technology is a positive case in disaster situations since they provide critical data information to audiences. Aim of the study; for the best methods that can be used to reduce the damage caused in the disaster areas. Aerial altitude platform systems AAPS have the potential to deliver a range of communication services and other applications such as broadband in disaster and isolated areas. This technology has faced impediments when they are used, is the instability communications systems for the transmission and connectivity with other network nodes due to the absence of the LoS between deployment nodes. According to Hariyanto, for the Emergency Broadband Access Network Using Low Altitude platform (EBAN), one of the challenges that the EBAN project faced was the problem in fluctuation of the balloon with winds [1], once an AAPS swings in reaction to the fluctuation of wind, the communication system also swings. Previous concept contributed to reduce the use this technology, for this reason has been innovating system has the ability to give consistency and stability, to communications equipment's, which in turn has increased the deployment of the network to reach areas that are difficult to the traditional methods to be achieved. A smart communication platform system (SCPS) base station [2], as a sky-tower is a solution to overcome the restrictions besides

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the ability to deploy the network to large-scale with a high QoS includes on a hybrid of Communication Systems, i.e., fiber-optic cable (FOC), FSO and radio frequency (RF).

Disaster case requires a QoS to address the recovery scenario. Quality services that obtained by integrating FSO system with SCPS to increase the transmissions bandwidth in the 'last mile' of the network deployment. Fig. 1 shows the proposed topology in this research.

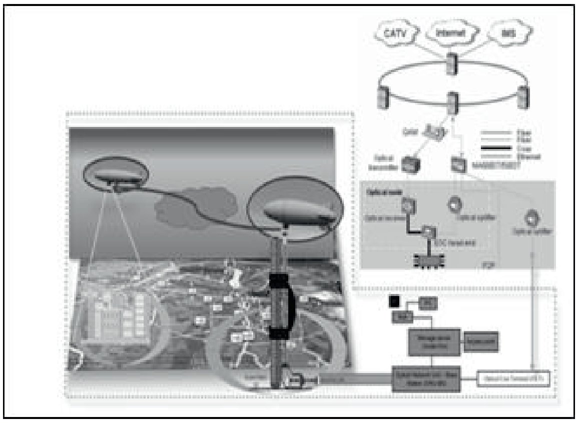

Fig. 1. Aerial Altitude Platform System (AAPS) Scenario Topology.

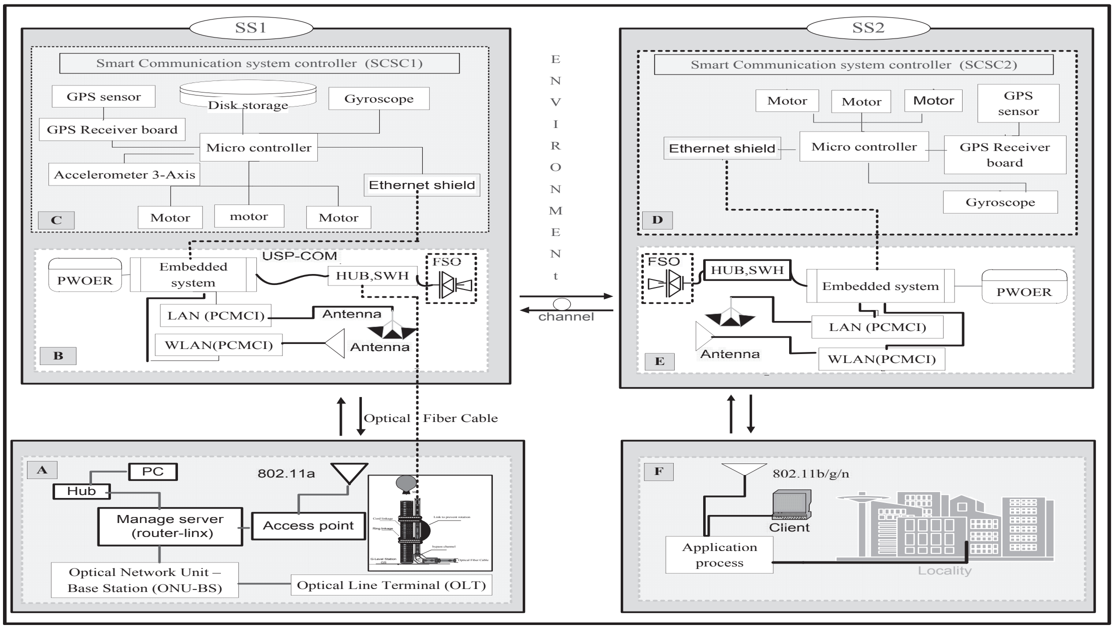

Fig. 2. Network Architecture Design.

2. Network Architectural

Once disaster happened, communication network seriously damaged and communication means cannot be used in the disaster area. Therefore, it is prerequisite to organize emergency network system which can be rapidly reconstructed to recover from the network failure. Communication system infrastructures in the disaster area were damaged such as disconnection of optical fiber cables, destruction of cellular phone stations [3]-[4].

Through the above challenges requires the creation of a system have the ability to solve the constraints, our proposal was to use a four stations, i.e., 1) ground node, which is the source of supply network service. 2) two-node platform station, the main stage sky station1 (SS1) is located within a low level of the ground of deployment and the second node sky station two (SS2) to receive the transmit signal from SS1. 3) End-system, which refers to the affected areas. Fig. 2 illustrates the deployment of network nodes components.

GS, that showing in fig. 2(A) which was considered to be the gate to receive the service through a fiber-optic cable. Characteristics connecting paths mechanism in the following steps:

- Radio frequency (RF) Phase: the ground station (GS) connects to SS1 via the IEEE 802.11a an .In second step, the SS1 is connected to the SS2 via RF antenna and all nods provide coverage area to the earth by utilizing the IEEE802.11.b/g/n standard.
- Optical cycle Phase: the GS connects to SS1 through a fiber-optic cable and RN is connected with SS2 via FSO system channel to increase the QoS to cover the intended area.
- To distribute high-quality service to the End-System, the communications equipment requires continuity in evidence transmission between nodes; this issue needs the establishment of a system control to guiding the signal and ensures the line of sight between nodes to prevent the lack of transmitted signal interruption and for communication stabilization improvement system.

3. Smart Communication Platform System (SCPS) Design

The SCPS design as shown in Figure 3 that was used in AAPS network structural construction, the design describes system components, and table1 are clarifying each constituent and its position in the system architectural. For further details on the structure and mechanism design performance can be obtained from our previous [2].

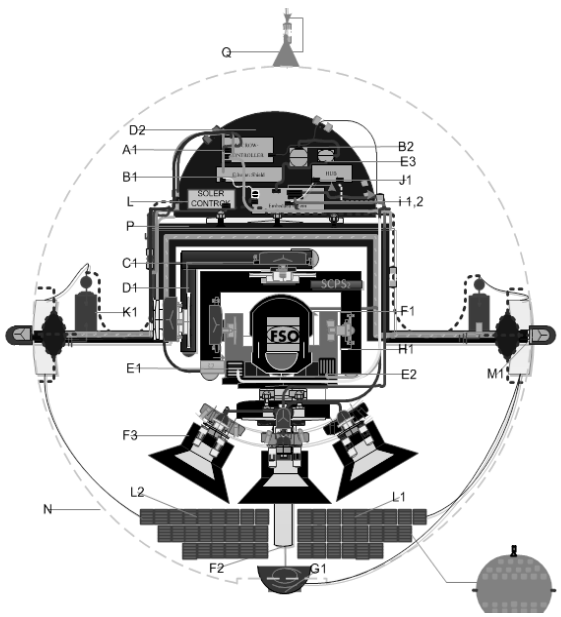

Fig. 3. Smart Communication Platform System Architectural [2].

Table 1. System components

No.	Type	Device	Specifications
1	A1	MICROWCONTROLLER	board
1	B1	Ethernet Shield	board
1	B2	GPS- SHIELD	board
3	C1	Motor	servo motor
3	D1	platform	
1	D2	platform box	
1	E1	Sensor	Accelerometer
1	E2	Sensor	Gyroscope
1	E3	Sensor	GPS
1	F1	Free Space Optics	FSO
1	F2	Antenna	802.11a
1	F3	Antenna	802.11b/g
1	G1	Camera	IP- camera
2	H1	WIGHET-PALLINCING	
1	I1	Embedded system + PCMCI-card	WAN&LAN
1	I2	PCMCI-card	
1	j1	HUB/SWH	802.113af
1	K1	Charger Battery	
1	L1	Solar Cells	
1	M1	Alarm Lamp	

The operation which requires transferring a variables factor that influence in the SCPS, from the physical to the digital world. To transferal the environmental effect factors of the communication equipment's to the sensors that are installed in the smart communication system control (SCSC) which was clarified in Figure 2 (C) and (D) responsible for these procedures', an 3-axis accelerometer sensor that marked with the symbol (E1) and is fixed in D1 to interact with the vector of the outside force (R). The R vector be measured by the accelerometer sensor[5], whereby the extracting the coordinate of the SCPS, i.e., Rx, Ry, Rz projections of the R vector on the X, Y, and Z planes, respectively. The R position of SCPS, which measures via accelerometer, is sent to a gyroscope through the micro-controller that is compatible with the sensors. The 3-axis gyroscope is marked with a symbol (E2) in Figure 3, is a device for measuring and maintaining orientation. The SCPS coordinates position are sent to the gyroscope to be rotated in response to any change of direction, the gyroscope output data is processed by the micro-controller, and the signal is then sent to the motors to correct the SCPS direction and consequently ensuring a LoS between network nodes.

4. SCPS Performance

To evaluate the performance of the system, SCPS design was implemented In MATLAB environment, to test the direction-finding mechanism of system performance. In order to guide the system to the desired direction angle requires to establishment a control system to guide the platform to the desired angle, thus provide communications systems the aptitude to linkage with the other network nodes. Figure 4 illustrates the structure of the control system in SCPS.

SCPS guidance loop consists of Tracker/Target (T/T) subsystems that return measurements of the relative motion between the SCPS location and the target and the guidance subsystem that generates the angle demands that are passed to the tracker SCSC subsystem.

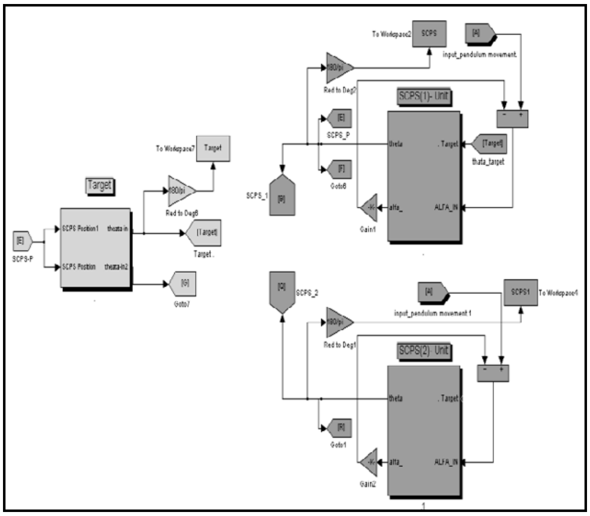

Fig. 4. Smart Communication System Control (SCSC) in SCPS.

The Rotation angle to desired target it is responsibility of the guidance system; the coordinates of the angle direction send to SCPS-1, which in turn the coordinates change under a new input via the guidance system. The coordinates of a new angle in turn sent to system SCPS-2 to be able to track and follow the movement of SCPS-1 to achieve stability and ensure the LoS between the transmission sides.To evaluate the performance of the system; SCPS design was implemented In MATLAB environment, to test the direction-finding mechanism of system performance. In order to guide the system to the desired direction angle requires to establishment a control system to guide the platform to the desired angle, thus provide communications systems the aptitude to linkage with the other network nodes.

5. Evaluation Results

In this section, we present the performance results, which in turn demonstrate the effectiveness of the SCPS performance.

The accelerometer in SCPS measures the vibration of motion and perform us position R vector in 3-axes, which is the inertial force vector as measured by the accelerometer. The angles of inclination transmit to the gyroscope depend in our algorithm.

Fig. 5 illustrates the practical experience to evaluate the performance of sensor .The accelerometer [5], measures sensitivity in a 3-axis direction, for the time period of (0-20) sec in order case of the system stability and for the period of (20-42) sec the direction of system deviation, that illustrated in the lower part of the diagrams (The line with the arrow in the diagrams shows the launch of the movement the system until the end).

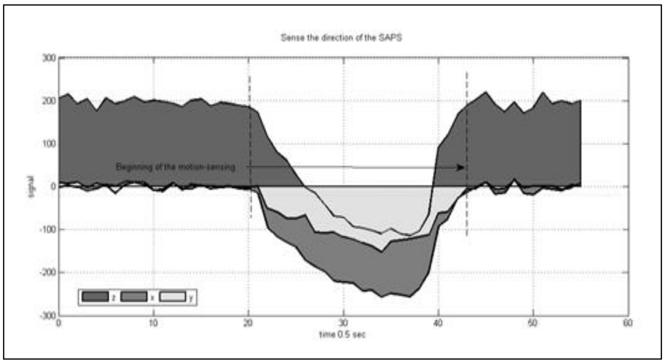

Fig. 5. Demonstrates the Response in 3- Axes.

Table 2 shows the experimental parameters that have been adopted by experience.

Table 2. Sensor Parameters

Parameter	Values
apply voltage range for Accelerometer	2.0 V to 3.6 V
Time movement Experimental	20-42 sec
X axis account numbers.	-300 to 300

In order to comprehend the SCPS attitude, necessity to recognize the behavior of the SCPS guidance and stability specifically, in the system's reaction to each direction change. Figure 6 shows the guidance angle which is supposed to respond to the SCPS-1 control system, target angle identified default rate of (- 30° degrees). Where we note that the SCPS-1 responded to this angle and began to change direction according to instruct of guidance system, therefore the SCPS-2 trace the movement of SCPS-1 and then change the direction of its movement toward the required angle.

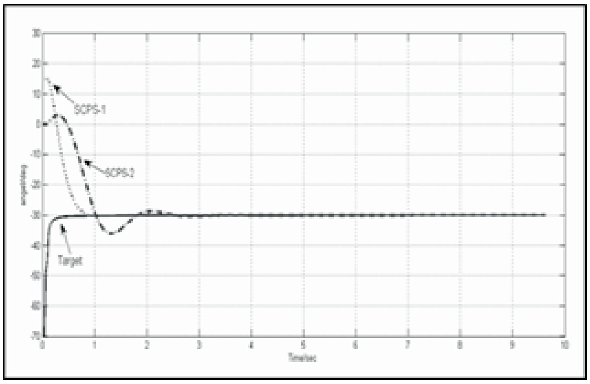

Fig. 6. Angle of the Target.

In this experiment has been the complexity of the test performance of the system where we note an increase phase difference between the desired angle direction and the location of the SCPS-1, where the movement started from the angle of (15°) to the angle (-30°).

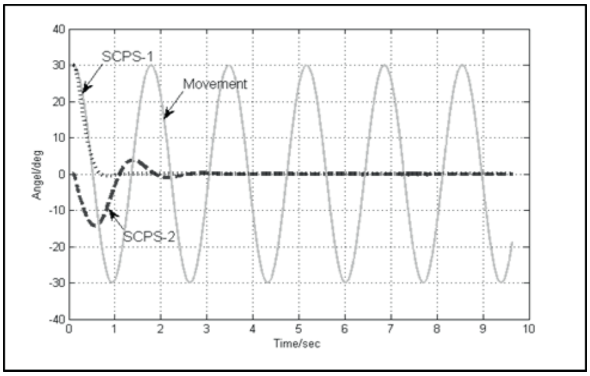

Fig. 7. Systems Response.

In figure 7 shows the signal behavior when the limitation of the initial movement angular is set to be (±30°).To test the direction-finding mechanism of system performance, SCPS-1 in case of instability due to sine wave movement imposed on the control system to check the efficiency of the system response. The second system began to move from (0°) state, tracked the effect of the first movement, which as of (30°).In this case systems are trying to realize stability, despite the random movement, which has been imposed on the systems.

Through the results could extract the following concept, i.e., 1) SCPS control systems has succeeded to pursue the movement that affecting on the AAPS.2) pursue movement has been achieved, thus confirmed the line of sight between the two systems.

6. Conclusion

In this paper, performance was evaluated of smart communication platform system to overcome the restrictions facing aerial altitude platform stations. We had been evaluating the performance and capacity of SCPS to address the situation of stability as a result of fluctuation and swing of the AAPS nodes by the wind. A fluctuation in the platform makes communications systems lose the ability to communicate with the other network nodes due to loss of the LoS between both transmission sides. Achievement the stability in dealing difficult situations because of fluctuation in platform installation enhances the role of communications systems to perform tasks and achieve the desired objective.

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